Pretty soon, plants-instead of crude oil-might serve as the source for plastic.

Plastic is practical—and cheap. But the future of crude oil, the stuff that plastic is made of, is uncertain. That’s one reason why scientists around the world are on the hunt for an alternative precursor to plastic, preferably an environment-friendly one. Often, however, such green precursors are produced by nature at very low rates, which makes commercial production of green plastic unfeasible. Now, scientists at the Brookhaven National Laboratory have come up with a way to produce plastic from plants at commercially-viable rates.

Plants produce oils - think of canola, olives, and cottonseed. The building blocks of oils are fatty acids, which can be modified to express a specific quality desirable to scientists. Shanklin has long been interested in fatty acids that are precursors to plastic. The magical fatty acids are called omega 7 fatty acids, which are unique in that certain carbon atoms are not linked to hydrogen atoms; instead they are linked with an extra bond to an adjacent carbon atom. Such fatty acids are normally found in the seeds of cat's claw vine and milkweed, but these plants produce only small amounts of the fatty acid.

To increase production, scientists worked with Arabidopsis, a genus of plants often used for genetic research because its genome is easily modified. They modified the plant's genome by introducing a gene that codes for desaturases - enzymes that eliminate the extra hydrogen atoms - thereby producing double carbon bonds. Even with this change, only 2 percent of the plant's seeds had the necessary fatty acids. But the team needed to be producing "a commercial product of omega-7 oil fatty acid," according to Tam Nguyen, another member of the team, so the team modified the enzyme to work faster. This raised the production rate to 14 percent, but it was still not enough for commercial use.

Researchers realized that some of the fatty acids were escaping the necessary desaturation process, so they had to come up with a way to desaturate the fatty acid in stages. The desaturase produced by the research team, called Com25, works in the plastid (a form of chloroplast) of the plant. "Fatty acids are made in the plastid, so Com25 gets first shot at desaturating them," Shanklin said.

But some fatty acids escape this process and slide out of the chloroplast into the cytosol of the cell. To combat this problem, the team introduced fungal desaturases that work in the cytosol and are able to desaturate the escaped fatty acids. The team tried further modifications until they finally came up with a boosted production rate. At the end of the process, "71 percent of all the fatty acids in the seeds [were] omega 7," said Shanklin, which is a commercially viable result.

The process of turning plant oils into plastic is not yet complete. Because the desaturated fatty acids are a precursor to the plastic, they have to go through another transformation - a process that is currently being developed by the Dow Chemical Co. Nevertheless, this study is important in bringing to light another renewable natural resource, a topic that has piqued the interest of scientists all over the world. Explains Terence Walsh, a research scientist employed by Dow, who collaborated with Shanklin on the study, “The significance of the research is that we showed that plants can be engineered to produce high levels of omega-7 fatty acids.”

The team hopes that plastic derived from plants will be as diverse in its uses as petroleum-based plastic. Says Walsh, “Ideally, the final plastic products made from [plants] would not be different from those currently derived [from] petroleum.”

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